PLATFORM
TBC

PLATFORM CLOSES
10.00

CARRIAGE
34

PHYSICS P1

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TRAIN TICKET

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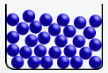
P1

DEPARTURE: __.__.20__ JOURNEY TIME: 1 hr

PLATFORM: TBC

Particles in a **solid** **vibrate** around their fixed positions. The forces between the particles are strong which is why they are close together. Solids have a fixed shape, fixed volume and high density.

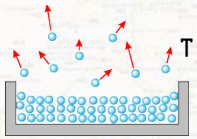
In **liquids** the particles have more energy than in solids. The forces between the particles are still strong, but the particles can **slide** past each other. This means that liquids have a fixed volume but can take on the shape of their container (we say that a liquid can flow).



Topic

KINETIC THEORY

1st WALES Class



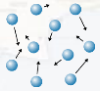
When a liquid is heated it **evaporates**. Particles with high energy overcome the forces between the particles and leave the liquid. The **mean energy** of the particles left behind is lower and the temperature of the liquid drops. To speed up evaporation, increase the surface area or temperature of the liquid and create a draught across the liquid's surface.

Exam practice

Video

During **condensation** steam turns into liquid water and collects on a surface. The particles lose energy and move closer together. The forces of attraction between the particles increase. To speed up condensation, increase the surface area of the surface or reduce the temperature of the surface.

Particles in a **gas** have more energy than those in a liquid and solid. They move quickly and at random which means the particles are spread out. The **forces** between the particles are weak. Gases fill their containers, have no fixed volume and have a low density.



EXAM RESPONSE JOURNEY PLANNER

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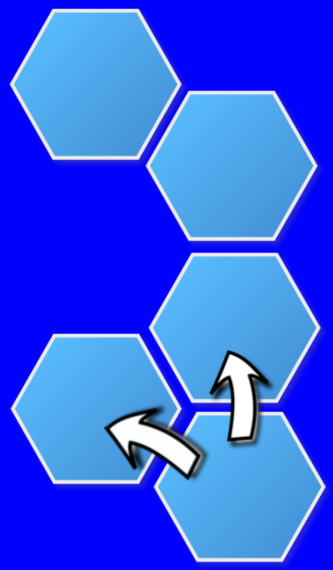

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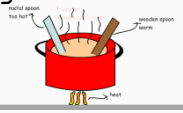
P1

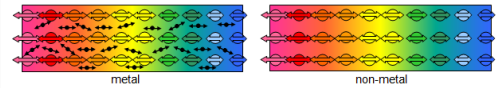
DEPARTURE: __.__.20__ JOURNEY TIME: 1 hr

PLATFORM: TBC

Energy can be **transferred** usefully, **stored** or **dissipated**, but cannot be created or destroyed.

Conduction is the heat transfer in **solids**. Heat passes through a material by transmitting **vibrations** from one particle to the next. Conduction occurs in solids as the particles are close together. **Metals** are excellent conductors of heat. The **delocalised electrons** gain kinetic energy and collide with other free electrons and metal ions throughout the metal. Energy is transferred quickly.



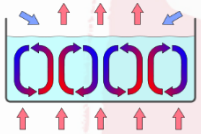


Topic

Heat Transfer

1st Class

Convection is the heat transfer in **fluids** (liquids and gases) due to **convection currents** within the fluid: water particles at the bottom of a pan gain energy, **move** faster and spread out. The **density** of the water decreases and hot water rises. The hot water is replaced by cold water. When the particles lose energy, they move closer together. The density of water increases and cold water sinks to the bottom. Hot water tanks, radiators and kettles all make use of convection currents.



Exam practice

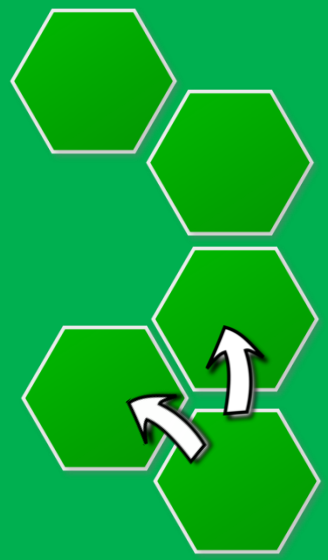
Video

- Radiators often have **fins**. This increases the **surface area** of the radiator to increase the rate of heat transfer.
- Double glazing prevents heat transfer via convection and conduction because the vacuum between the two glass panes does not contain any particles.
- A vacuum flask is designed to prevent heat loss by convection, conduction and radiation. Inside the flask is a double-walled glass container. Between the walls is a vacuum. The glass walls are painted silver to prevent heat loss via radiation. The glass container sits on a plastic spring to prevent conduction and a plastic cap at the top prevents heat loss via convection.

All warm objects emit **infrared radiation**, an electromagnetic wave that can travel through a **vacuum**. Unlike conduction and convection, heat transfer via radiation does not require particles.

EXAM RESPONSE JOURNEY PLANNER

Link the keywords to help you sequence your ideas



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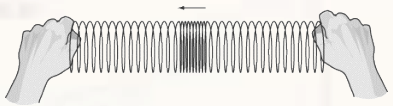
PLATFORM: TBC

Topic Waves

Waves are **disturbances** that transfer energy from one place to another. There are **mechanical** waves (**vibrations** that disturb a medium such as water or sound waves) and **electromagnetic** waves (disturbances in electric and magnetic fields such as light and radio waves).

Sound waves are **longitudinal** waves. The **oscillations** of the wave are parallel to the direction of energy transfer.

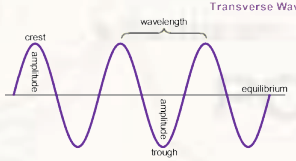
Longitudinal waves are divided into areas of compression and rarefaction.



The higher the **amplitude**, the louder the sound is. The higher the **frequency** and the shorter the **wavelength**, the higher the pitch of the sound is.

Electromagnetic waves are **transverse** waves. The oscillations of the wave are **perpendicular** to the direction of energy transfer.

All EM waves travel at the speed of light (300 000 000m/s) through a **vacuum**.

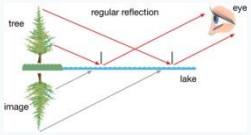


The speed of a wave is calculated this way:
speed v = frequency f(Hz) x wavelength λ(m)
The frequency is the number of waves passing a point in one second. The wavelength is the distance from one wave crest to the next **crest**.

Exam practice

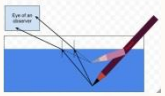
Video

The law of **reflection** states that **the angle of incidence = angle of reflection**.

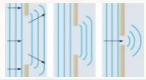


An image in the mirror is **virtual** because it is formed behind the **mirror**. The image is also **real and upright**.

Refraction: when light travels from one **medium** to another, it changes direction because it's speed has changed; this is due to the **density** of the medium having changed.



Diffraction is the **spreading** of waves when they pass through a **gap** or around the edges of an obstacle which has a similar size as the wavelength of the wave. The smaller the gap, the greater the diffraction.



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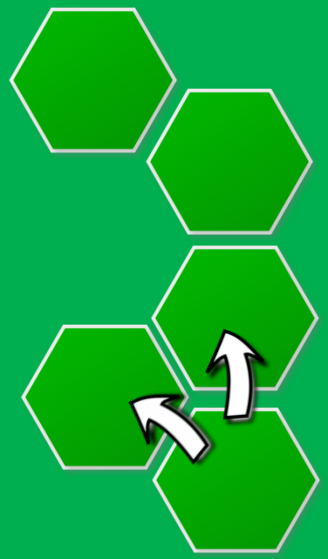

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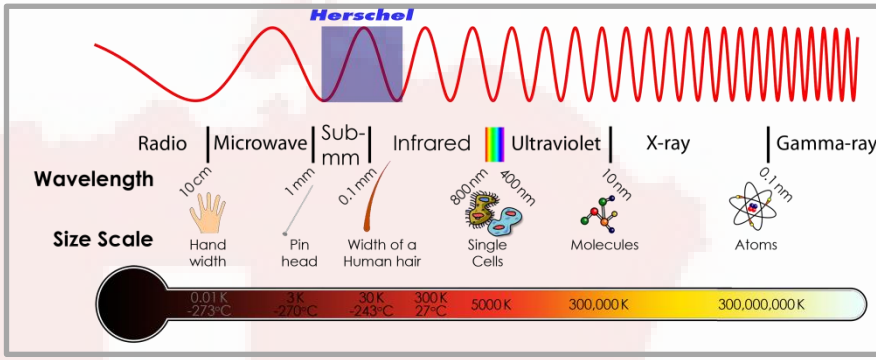
All EM waves are **transverse** waves and travel at 300 000 000m/s through a **vacuum**. They differ in their frequency, wavelength and energy. The energy of the waves increases with frequency. Gamma rays carry most energy, radio the least.



Rich Men In Love Use Extra Gel

Topic
EM Spectrum

1st Class

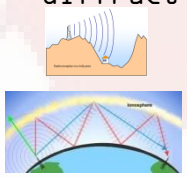
All EM waves are used for **communication**.
White light: photography

IR: Remote controls, IR scanners, thermal imaging cameras, optical fibres.
Optical fibres are used as light cannot escape from the thin glass fibres. When the IR rays reach the surface of the fibre, they are **reflected back** into the fibre. Optical fibres can carry large amounts of information (IR has a smaller wavelength than radio waves) and signals can be transferred securely.

Exam practice

Video

Radio waves are used for TV and radio broadcasting. In hilly areas reception can be a problem if the wavelength of the radio wave is too short and the waves do not diffract sufficiently. Radio waves with long wavelength are used for international **broadcasting** as they have a longer range.



Microwaves, unlike radio waves, can pass through the Earth's **ionosphere**. Therefore, microwaves are used for **satellite** TV, mobile phone communication and GPS tracking systems. Microwaves have a heating effect on water which is why they are used to **cook** food. This is why some people worry that using mobile phones can also damage body cells and lead to cancer, especially in teenagers. The microwaves used for **mobile phone** communication carry less energy than those used in cooling.

EXAM RESPONSE JOURNEY PLANNER

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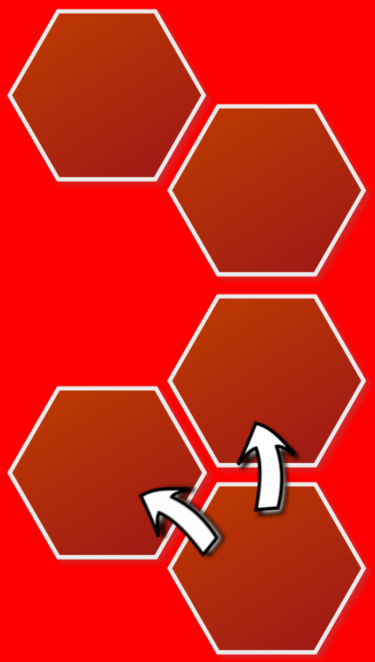

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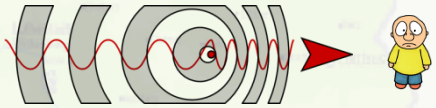
PLATFORM: TBC

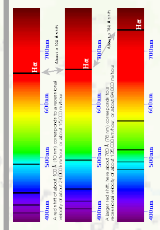
When a source that emits sound moves away from the observer, the **observed wavelength** increases and the frequency decreases; when the source moves towards the observer, the observed wavelength decreases and the frequency increases.

This is known as the **Doppler Effect**. When an ambulance is driving towards you, the siren sounds quite high pitched. As the ambulance drives past and away from you, the pitch changes and is lowered. This is the Doppler Effect in action.



Topic

Redshift



Galaxies are made of billions of stars that emit light. When scientists observe galaxies from Earth, they can determine whether the galaxy is moving towards us or away from us.

If the galaxy is moving away from us, we will observe the **stretched out** light waves, which have a longer wavelength that is in the red part of the spectrum. We say we observe a **red-shift**. If the galaxy is moving towards us, we observe a **blue-shift**.

Exam practice

Video

Redshift provides evidence for the Big Bang. Redshift not only determines the distance of the galaxy from Earth, but also how fast the galaxy is moving. A famous scientist called Edwin Hubble discovered that the light from distant galaxies is red-shifted and that the redshift is bigger for distant galaxies. This proves that the Universe is **expanding**. As the relationship is directly proportional, all matter must have started off at the same point at some time.

Scientists believe that the **Universe** started in one place. A huge explosion took place and sent matter outwards. The Universe has been expanding ever since. **Cosmic microwave background radiation** created just after the Big Bang can still be detected nowadays and can only be explained by the **Big Bang theory**.

EXAM RESPONSE JOURNEY PLANNER

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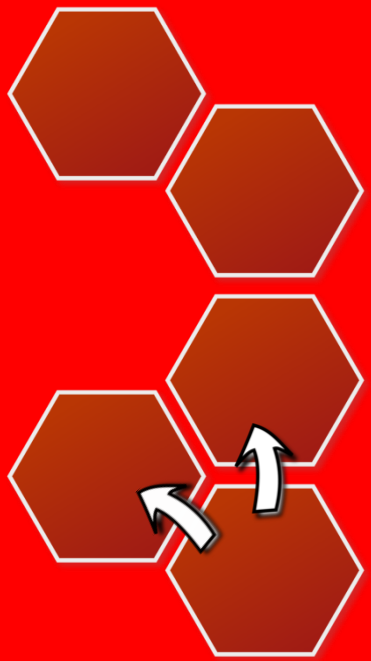

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P1

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PLATFORM: TBC

Topic

Insulating buildings

1st Class

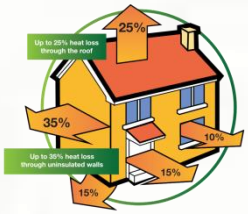
All hot objects transfer energy to their surroundings. The greater the difference in temperature between the object and the surroundings, the faster the rate of energy transfer is. For example, if you want to quickly make some ice cubes use warm water and place it in the freezer. If you want to cool down your soup faster heat it up to a higher temperature.

Other factors that affect the rate of energy transfer are:

- The material of the object (darker materials emit energy at a faster rate than lighter materials)
- The material the object is in contact with (if in contact with a conductor, the rate of energy transfer will be higher)
- The object's shape and surface area to volume ratio

Home **heating bills** can be very expensive. Home owners need to think carefully about how to best insulate their homes. Some **insulation** methods might be very pricey, but bring other benefits. Double glazing for example also improves the security of the home, keeps the traffic noise out and raises the value of the home.

When choosing insulation materials, opt for those that have a low **U-value**. The lower the U-value, the more effective the material is as an insulator.



Exam practice

Video

Payback time is the time taken to save as much money as it cost originally to install the energy saving measure:

Payback time = **installation cost/annual savings.**

For example, if loft insulation costs £250 to install but reduces the energy bill by £50 a year, the payback time is 5 years. Because some insulation measures are very expensive, government grants are available to install some types of insulation.

Energy transfer from homes can be reduced by installing the following:

- **Loft insulation** (made of **fibre glass** which traps air between the fibres so convection currents cannot happen)
- **Cavity wall insulation** (**polystyrene** balls fill the cavity and traps air in small pockets)
- **Double glazing** (vacuum between glass panels prevents heat loss by convection and conduction)
- **Aluminium foil** behind radiators (radiation is reflected back into the room)
- **Draught proofing** doors and windows

EXAM RESPONSE JOURNEY PLANNER

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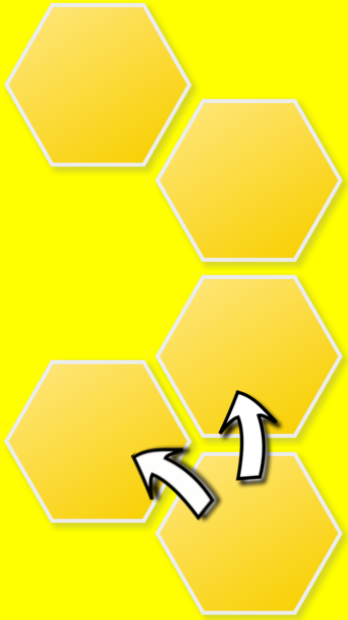

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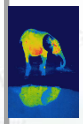

Every object emits infrared radiation (heat). The hotter the object is, the more IR radiation it emits. The police, army and others can make use of this fact when searching for humans or tracking animals with IR cameras. These cameras work best at night time as the temperature difference between the object and the surroundings is larger.

Different surfaces absorb and emit infrared radiation at different rates. Black, matt surfaces are best at absorbing and emitting heat, which is why stoves are painted this colour. They absorb the heat from the fire and emit it quickly into the room.

Fridges on the other hand are painted white or silver so that they do not absorb heat energy from the room. Otherwise this heat could be emitted into the fridge and warm up the contents instead of keeping them cool. Instead, the fridge surface reflects the IR radiation.

Topic
IR Radiation

Infrared radiation also links to the greenhouse effect. Gases in the atmosphere absorb IR radiation and lead to a warming of the atmosphere. Without this effect, it would be too cold on Earth and living organisms would probably not survive. Too many greenhouse gases however could trap too much IR radiation which could lead to global warming.

Exam practice

Video

Further applications of IR radiation:

Thermal blankets are silver and shiny to reflect the body heat radiated back to the person.

A solar hot water panel has different surfaces to maximise the amount of heat transferred to the water inside it. The water pipes are placed under a black surface. Solar radiation is absorbed by the black surface and used to heat the water inside the pipes. A shiny surface is placed underneath the pipes to ensure any heat emitted by the hot water and pipes is reflected back towards the water.

EXAM RESPONSE JOURNEY PLANNER

Link the keywords to help you sequence your ideas

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DEPARTURE: __._._20__ JOURNEY TIME: 1 hr

PLATFORM: TBC

Topic

Generating electricity

Non-renewable energy resources are **fossil fuels** and nuclear fuels. In both types of power stations heat is created which is used to produce **steam**. The steam turns a **turbine** which is attached to an electricity **generator**. Fossil fuel power stations do not take up large areas of land but they do release large amounts of CO_2, a **greenhouse gas**. Gas power stations have a short **start-up time**. This means that they can be switched on quickly and meet **surges** in electricity demand.

Advantages and disadvantages of **nuclear** power stations:
In a nuclear power station, **radioactive waste** is left behind. To remove this waste (**decommission** the power plant) is expensive. However, nuclear fuel is a **concentrated** source of energy and no CO_2 is emitted either.

There are many **renewable energy** resource alternatives. Each brings its own advantages and disadvantages. **Biofuel**, or methane gas, comes from decaying plant and animal material. When burnt, it also releases CO_2, however, it is considered **carbon neutral** if plant material is used. It also reduces the need for landfill space.

Solar power is **carbon free** and can be used in remote areas where there is no access to the National Grid. However, it relies on it being sunny.

Exam practice

Video

A **tidal** power station traps water from a tide behind a **barrage**. The water is then released through turbines which drive generators. Tidal barrages affect river **estuary habitats**. **Hydroelectric** schemes trap water behind a **dam**. The water is then allowed to flow downhill and turn a series of turbines. To create a hydroelectric scheme, a habitat is **flooded** and destroyed.

Wind turbines are electricity generators that are attached to turbine **blades**. No fuel is needed so it is considered carbon free. However, wind power is **unreliable** as it relies on the weather.

Wave generators use waves to a make a floating generator move up and down. Wave power is also unreliable as it relies on the weather and the wave generators might affect habitats of marine life and birds.

EXAM RESPONSE JOURNEY PLANNER

Link the keywords to help you sequence your ideas

P1

DEPARTURE: __.__.20__ JOURNEY TIME: 1 hr

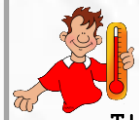
PLATFORM: TBC

Topic
Specific heat capacity

When a substance is heated, its **temperature** rise will depend on three factors:

- The amount of energy that is supplied to the substance
- The mass of the substance
- The material the substance is made of.

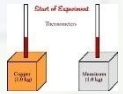
To raise the temperature of 1kg of a substance by 1°C, a certain amount of energy needs to be supplied. The amount of energy needed to achieve this is called the **specific heat capacity**.



The unit of specific heat capacity is J/kg°C

To calculate the amount of energy needed for a known change of temperature of a known mass of a substance the following formula is used:

Energy =
mass x temperature change x specific heat capacity



Exam practice

Video

Water has a specific heat capacity of 4200J/kg°C. Oil has a specific heat capacity of 200J/kg°C. If the same amount of **energy** is supplied to both, oil and water, the oil will reach a higher temperature which is why some radiators are filled with oil instead of water.

Storage heaters use electricity to heat special bricks inside the heater. Theses bricks have a high specific heat capacity which means they store a lot of energy. They warm up slowly when the heater element is switched on and release energy slowly when the heater is switched off.

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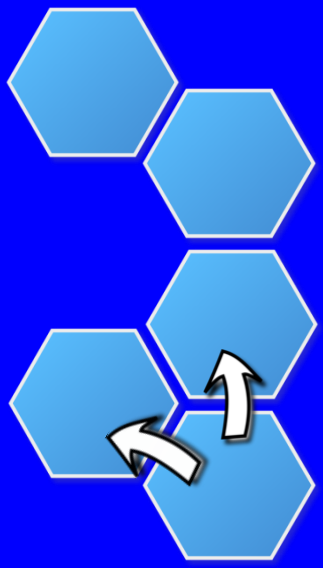

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P1

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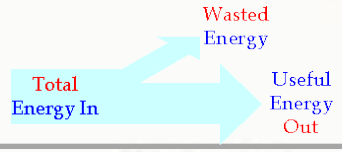
Electricity is transmitted from power stations to homes and businesses through the **National Grid**- a **network** of **cables** and **transformers**.
A step up transformer increases the **voltage** in the power cables and reduces the **current**. The cables heat up less and less energy is wasted. This increases the **efficiency** of the process. A step down transformer reduces the voltage so that electricity is supplied at 230V to homes.

A **Sankey diagram** shows energy transfers in devices. The width of each part of the arrow represents the proportion of energy. To work out the **efficiency** of a device, the total **useful energy output** is divided by the **total energy input**.



Topic

Electrical energy

1st Class

Electrical devices transfer electrical energy into other useful forms of **energy**. However, some of the electrical energy supplied to the device is also wasted.
For example, a hairdryer transfers **electrical** energy into useful **kinetic** energy, useful **heat** energy and waste **sound** energy. Other forms of energy you need to know are **light**, **elastic potential**, **gravitational potential**, **chemical** energy. To improve the efficiency of machines and get it as close to 100% as possible, moving parts are lubricated, electrical wires with low resistance are used, shapes are streamlined and loose parts are tightened.

Exam practice

Video

Electrical power (measured in Watts W) is the amount of energy supplied every second.

Power = Energy (J)/time(s)
more **energy transferred** per second, the higher the **power rating** of the device.

Efficiency can also be calculated using useful power out/total power in x100%.

Electrical appliances use electrical energy. To calculate how much energy is used, find the power rating of the device and multiply this value by the number of hours used for:
Energy transferred(kWh) = power(kW) x time(hrs)
An electricity company will then charge you according to how many kWh of energy you have used each month:
Total cost = number of **kWh** used x cost per kWh.

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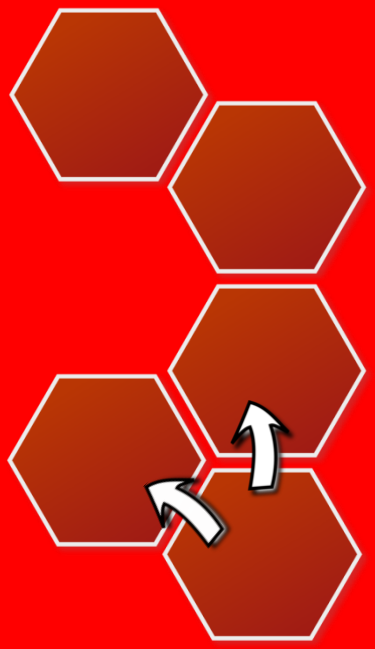
EXAM RESPONSE JOURNEY PLANNER

Link the keywords to help you sequence your ideas



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